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Andreadakis

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[54] **GAS-FILLED DOT MATRIX DISPLAY PANEL**

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[73] Assignee: **Burroughs Corporation,** Detroit, Mich.

[21] Appl. No.: **445,209**

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[51] **Int. Cl.**[3] **H01J 17/49;** G09G 3/28

[52] **U.S. Cl.** **313/586;** 340/714; 315/169.1

[58] **Field of Search** 40/447; 340/714, 716, 340/769, 771, 792, 799; 315/169.1, 169.2, 169.3, 169.4; 313/584, 562, 586, 585

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,701,924	10/1972	Glaser	315/169.1
3,704,386	11/1972	Cola	315/169.1
3,714,506	1/1973	Kupsky	315/169.1
3,766,420	10/1973	Ogle et al.	313/584
3,872,346	3/1975	Kunii	315/169.1
3,878,422	4/1975	Brown et al.	315/169.1
4,162,427	7/1979	Kamegaya et al.	315/169.1
4,302,706	11/1981	Dubois	315/169.1
4,315,259	2/1982	McKee et al.	315/169.4
4,329,616	5/1982	Holz et al.	313/584
4,342,993	8/1982	Holz	315/169.4
4,352,040	9/1982	Andreadakis	313/584
4,373,157	2/1983	Holz et al.	315/169.4
4,378,649	4/1983	Cokefair	315/169.3
4,386,348	5/1983	Holz et al.	315/169.1
4,414,490	11/1983	Harvey	315/169.2

FOREIGN PATENT DOCUMENTS

2321763	3/1977	France	313/584

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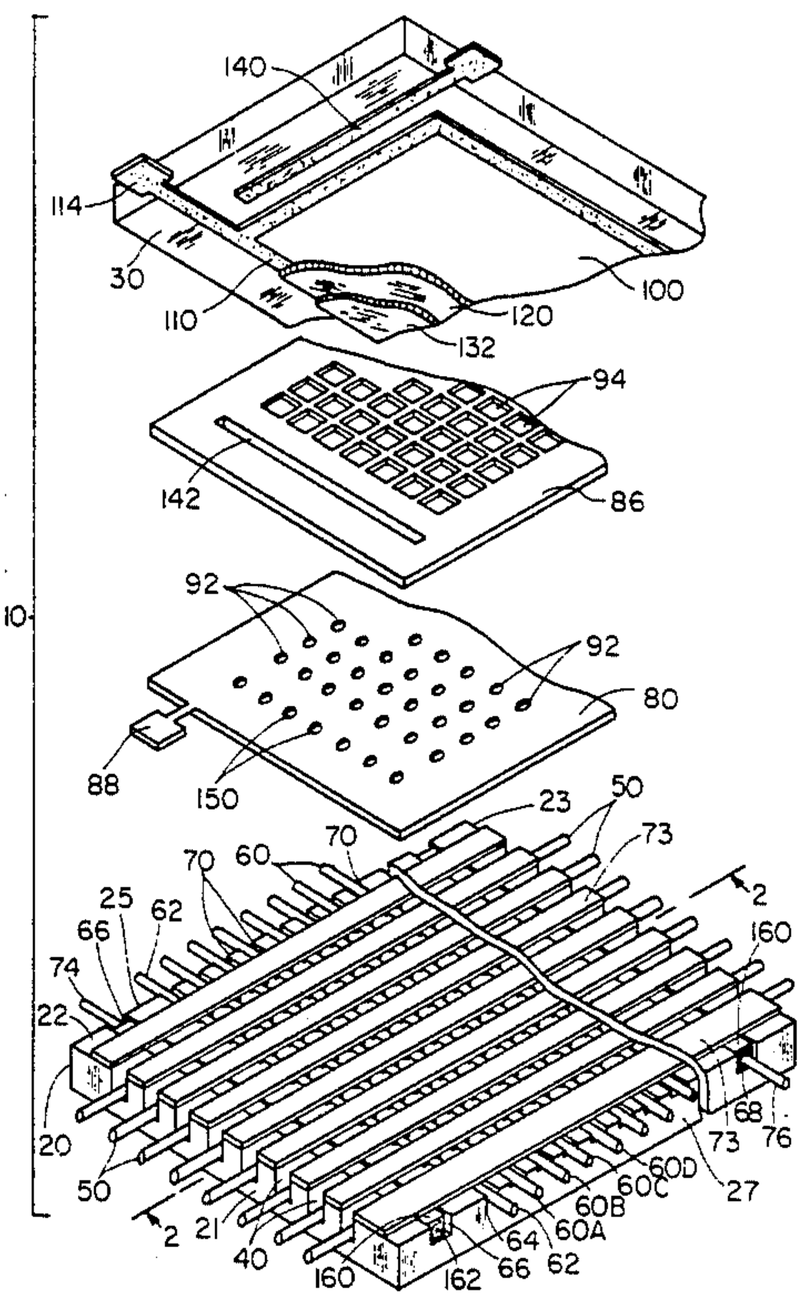
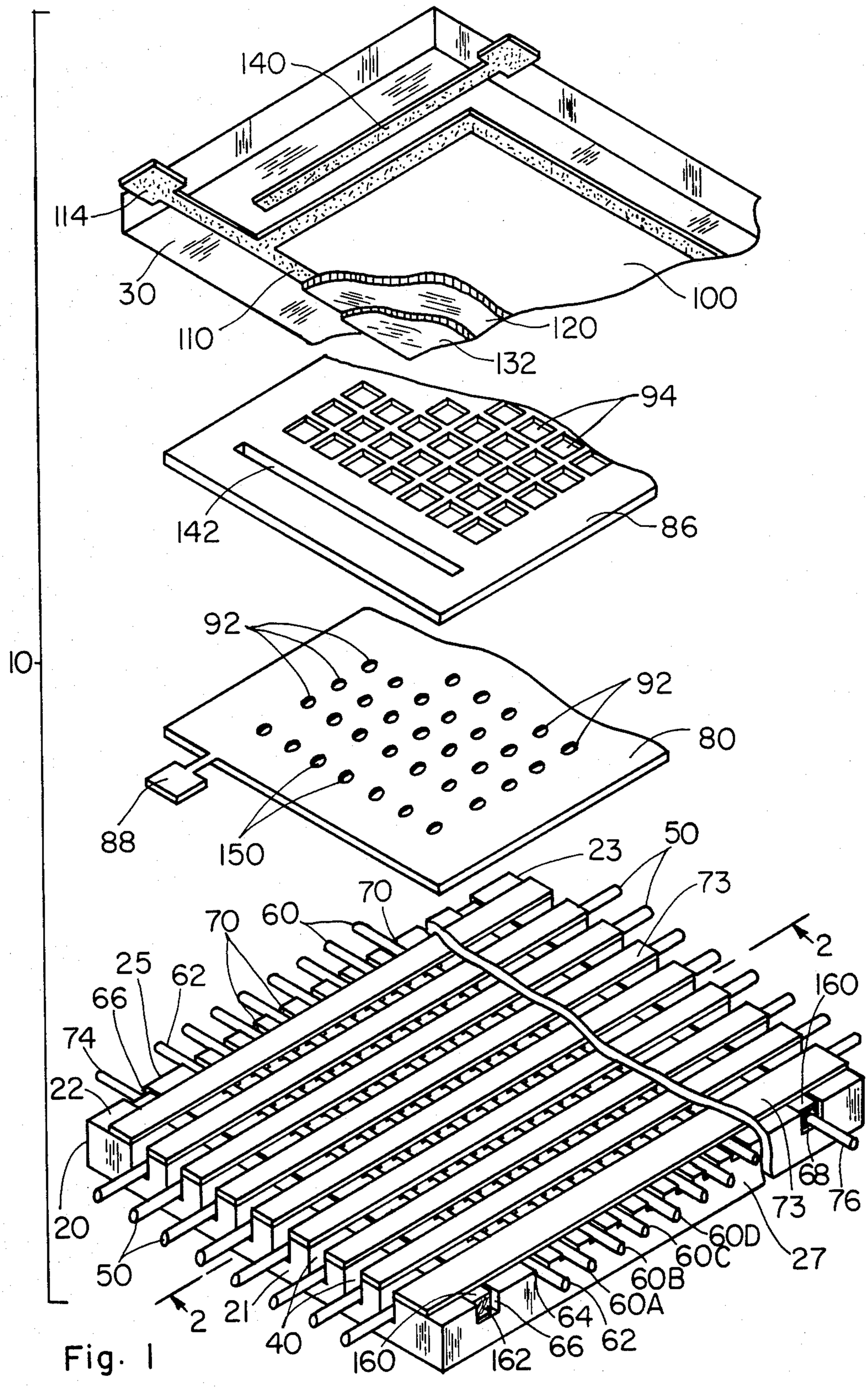
[57] **ABSTRACT**

A gas-filled display panel comprising a glass base plate and a glass face plate hermetically sealed together along a perimeter seal area to form an envelope which is filled with an ionizable gas, the base plate having an array of longitudinal slots in which anode wires are seated and having an array of cathode electrodes on the top surface thereof. The base plate has cross grooves transverse to the slots and positioned one near each end of the base plate, and a glass rod is secured in each cross groove with the ends of each rod lying within the seal area between the base plate and the face plate, the top surface of each insulating member being generally coplanar with the top surface of the base plate in the seal area, to insure the formation of a hermetic seal between the base plate and face plate at the cross grooves.

6 Claims, 3 Drawing Figures

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70
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62
66
74
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20
50
2
21
40
160
162
64
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62
60A
60B
60C
60D
27
73
68
76
160
2

Fig. 1

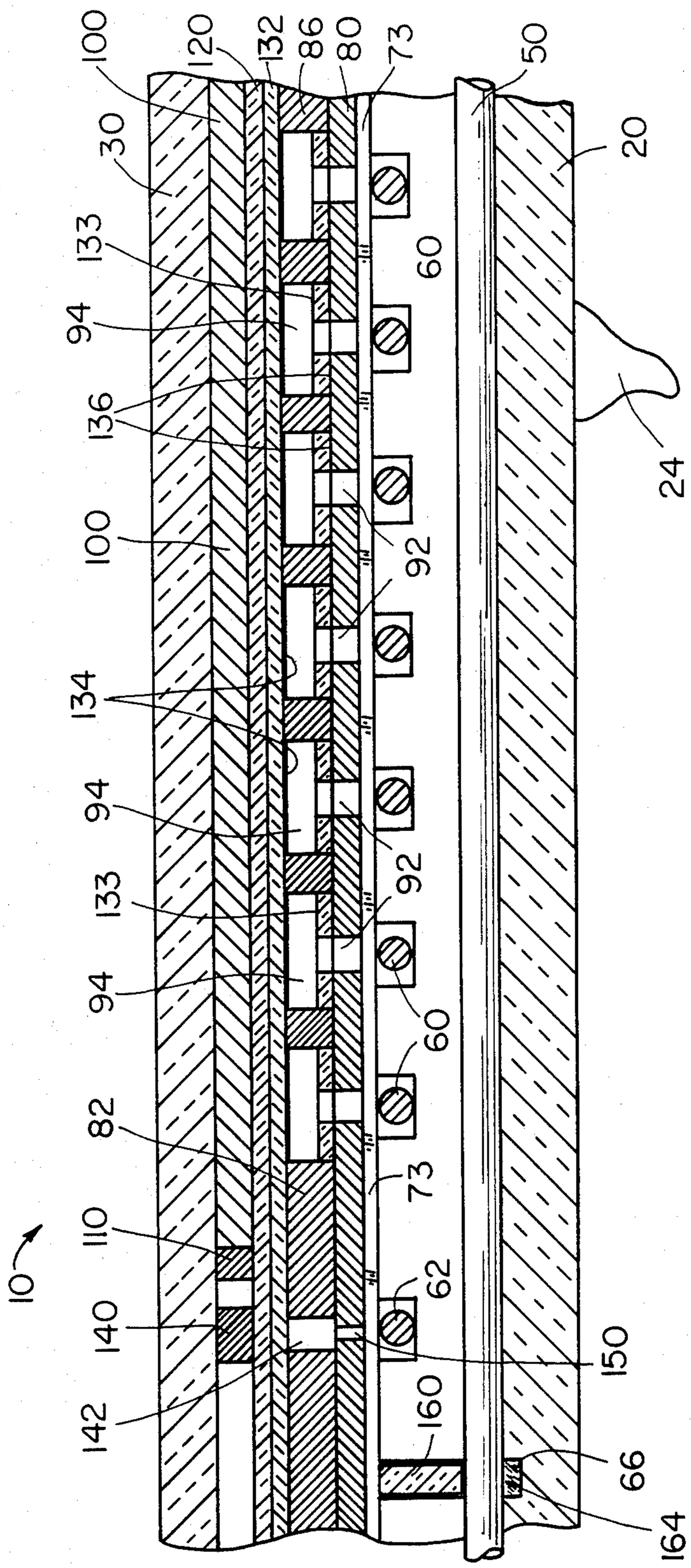
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Fig. 2

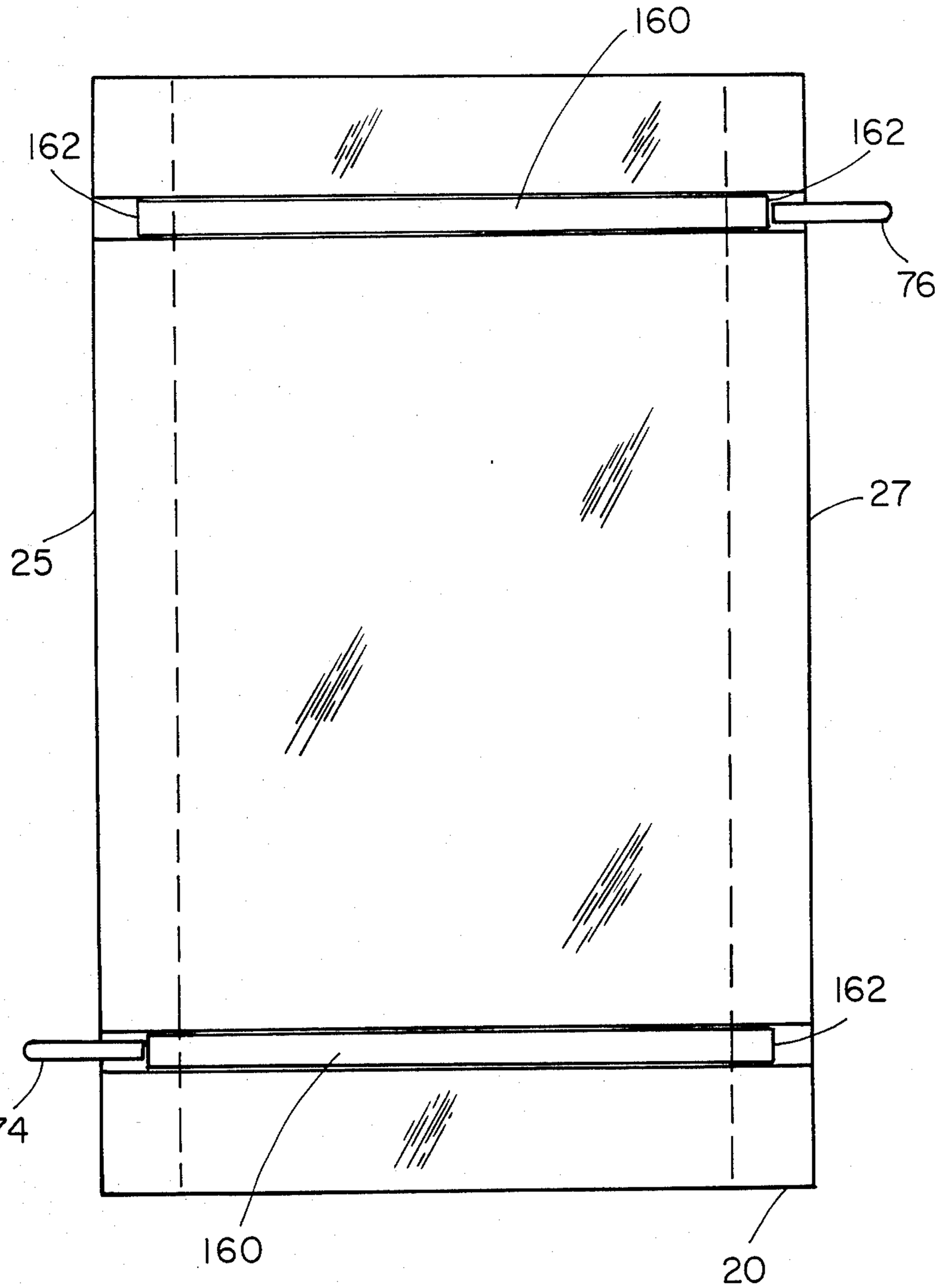

Fig. 3

GAS-FILLED DOT MATRIX DISPLAY PANEL

BACKGROUND OF THE INVENTION

A gas-filled dot matrix display panel having memory is disclosed in copending application Ser. No. 051,313, now U.S. Pat. No. 4,386,348, filed June 22, 1979, of George E. Holz and James A. Ogle, which is incorporated herein by reference. This panel includes a matrix of D.C. scanning cells arrayed in rows and columns and a matrix of quasi A.C. display cells which are in operative relation with the scanning cells. In the panel, there is one scan cell for each display cell. The panel includes a relatively complex array of electrodes, and the scanning operation and addressing of display cells are relatively complex procedures.

This panel, in a rather large size, utilizes a cross groove at both ends of the base plate as part of the seal between the base plate and the face plate of the panel. The cross grooves are filled with sealing material which bonds to the face plate. This arrangement works generally satisfactorily; however, at times, the seal material in the cross grooves is of uneven thickness, and this prevents the formation of an hermetic seal between the base plate and face plate. A display panel using a cross groove of this type is shown in U.S. Pat. No. 4,352,040, dated Sept. 28, 1982, of Nicholas Andreadakis, which is incorporated herein by reference.

The present invention solves this problem in a manner described below.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective, exploded view, partly in section, of a dot matrix display panel embodying the invention;

FIG **2** is a sectional view of a portion of the display panel of FIG. **1** taken along lines **2—2** in FIG. **1**; and

FIG. **3** is a plan view of the base plate portion of the display panel of FIG. **1** showing only selected features of the invention.

DESCRIPTION OF THE INVENTION

The present invention is embodied in a display panel **10** of the type described and claimed in copending application of George E. Holz and James A. Ogle, Ser. No. 051,313, filed June 22, 1979, which is incorporated herein by reference, along with the patents and publications cited therein. This application describes a dot matrix memory display panel including a D.C. scan portion and an A.C. display portion.

The display panel **10** includes a gas-filled envelope made up of an insulating base plate **20** and a glass face plate 30, which are hermetically sealed together, along a closed periphery which surrounds the operating inner portion of the panel and the various gas cells provided therein. The base plate has left and right end edges **21** and **23** and upper and lower edges **25** and **27**. The base plate also has a top surface **22**, in which a plurality of relatively deep, parallel, longitudinal slots **40** are formed and in each of which a scan anode electrode **50** is seated and secured by means of a glass frit cement.

A plurality of cathode electrodes **60** are seated in shallow, parallel slots **70** in the top surface **22** of the base plate. The cathodes **60** are called scan cathodes, and they are disposed transverse to the slots **40** and to scan anodes **50**, and each crossing of a scan cathode **60** and a scan anode **50** defines a D.C. scan or scanning cell **72** (FIG. **2**). It can be seen that the anodes **50** and cathodes **60** form a matrix of such scanning cells which are arrayed in rows and columns.

The scan cathodes **60A**, **60B**, **60C**, etc., form a series of cathodes which are energized sequentially in a scanning cycle, with cathode **60A** being the first cathode energized in the scanning cycle.

A reset cathode electrode **62** is disposed adjacent to and parallel to the first scan cathode **60A**, in a slot **64**, and, where the reset cathode crosses the scan anodes, a column of reset cells is formed. These reset cells are turned on or energized at the beginning of each scanning cycle, and they generate excited particles which expedite the turn-on of the first column of scan cells associated with cathode **60A**.

Adjacent to the reset cathode **62** and its slot **64** and adjacent to end **21** of the base plate is a slot or groove **66**, known as a cross groove, which is sufficiently deep so that it extends slightly below the anodes slots **40**. A similar cross groove **68** is provided at the opposite end of the base plate.

An insulating layer is provided on the top surface of the base plate. This layer is made up of strips **73** of insulating material extending along each land between the pairs of anode slots **40** and adjacent to the upper and lower edges of the base plate.

Adjacent to the base plate or scan assembly described above is a quasi A.C. display assembly which includes a metal plate electrode **80**, known as the priming plate, which has a matrix of rows and columns of relatively small apertures or holes **92**, known as priming holes, with each column of priming holes aligned with and overlying one of the cathode portions **61**. The plate **80** is positioned close to cathodes **60** and is preferably seated on the layer of insulating strips **73**..

Seated on plate **80** is another apertured plate **86**, the glow isolator plate, having rows and columns of apertures **94** which are aligned with apertures **92** but are larger than apertures **92**. The apertures **94** comprise the display cells of panel **10**, and each is disposed above one of the holes **92**. The plate **86** may be of insulating material, or it may be of metal. Plates **80** and **86** may be made as one piece, if desired.

The quasi A.C. assembly also includes a face plate assembly which includes a single large-area transparent conductive electrode **100** on the inner surface of the plate **30**. A narrow conductor **110**, which outlines and reinforces the electrode layer **100** in conductive contact, serves to increase its conductivity, if necessary. The conductor **110** includes a suitable tab **114**, to which external connection can be made. The large-area electrode **100** is of sufficient area to overlie the entire array of display cells **94** in plate **86**. An insulating coating **120** of glass or the like covers electrode **100**.

Under some circumstances, it is desirable to coat the glass layer **120** with a low work function refractory layer **132** of magnesium oxide, thorium oxide, or the like.

In panel **10**, the apertures **94** in plate **86** comprise display cells, and, as can be seen in FIG. **2**, each display cell has one end wall **134** formed by a portion of insulating layer **132**, and an opposite end wall **136** formed by a portion of the top surface of plate **80**. To provide cell uniformity and to minimize sputtering, a coating of the material of layer **132** should also be provided on the base or lower wall **136** of each display cell **94**, such as the layer **133** shown in FIG. **2**.

It appears that optimum operation of the panel is achieved if the apertures or cells **94** are unsymmetrical in that insulating layers **120** and **132** together have a thickness greater than layer **133**. Indeed, layer **133** may even be thinner than layer **132**. Thus, the lower end wall **136** of each cell **94** will have a very high capacitance coupling to the cell, and layer **133** will consequently tend to form only a minimal wall charge in the operation described below. In one mode of construction, both layer **132** and layer **133** may be formed by an evaporation process, and layer **133** may be so thin that it is not completely continuous, which is a desirable quality. In any case, however, the character of this wall of the cell is affected by the aperture **92** in the metal plate **80**.

Panel **10** has a keep-alive arrangement, referred to above, which is described in U.S. Pat. No. 4,329,616 of George E. Holz and James A. Ogle and includes an A.C. electrode **140** in the form of a linear conductive film or layer of opaque metal, such as silver, provided on the inner surface of the face plate **30** adjacent to one edge of the transparent conductive electrode **100**. The A.C. keep-alive electrode **140** is positioned so that it is aligned with the column of reset cells and reset cathode **62**, to which it supplies excited particles. The A.C. keep-alive electrode **140** is covered by the insulating layers **120** and **132**. The plate **86** is provided with a slot **142**, and plate **80** is provided with a column of holes **150**, the slot **142** overlying and being aligned with the column of holes **150**, and both lie beneath and are aligned with the A.C. electrode **140**. The slot **142** in the plate **86** is narrower than the opaque A.C. electrode **140** so that a viewer, looking through face plate **30**, cannot see any glow which is present in slot **142** and holes **150**. Electrode **140** operates with plate **80** to produce glow discharge between them and produce excited particles in slot **142** and holes **150**. These excited particles are available to the reset cathode **62** and assist the firing of the column of reset cells.

The gas filling in panel **10** is preferably a Penning gas mixture of, for example, neon and a small percentage of xenon, at a pressure of about 400 Torr. When the panel has been constructed and evacuated, the gas filling is introduced through a tubulation **24** secured to base plate **20** (FIG. **2**), or a non-tubulated construction can be employed.

Systems for operating panel **10** are described in application Ser. No. 051,313 and in U.S. Pat. No. 4,315,259 of Joseph E. McKee and James Y. Lee. The operation of panel **10** will not be set forth herein.

The assembly of the panel of the invention and the use of the cross grooves **66** and **68** will now be discussed.

In assembling the panel **10**, wires which will form the anodes **50** are wound on a support member, known as a harp, and then they are seated in the grooves **40** in the base plate, with a glass frit cement provided at the ends of the grooves to anchor the ends of the anode wires in place. The same glass frit cement **164** (FIG. **2**) is also placed in the cross grooves to secure the anode wires in these grooves.

The ends of the cross grooves **66** and **68** form a portion of, and lie in the area of, the seal between the face plate and base plate, and, in order to insure that the cross grooves are filled just to the top surface **22** of the base plate, as is required for a proper hermetic seal, a glass rod **160** having a rectangular cross-section is seated in each of the cross grooves on the glass frit cement therein. The rods are designed so that their top surfaces are coplanar with the top surface **22** of the base plate when they are sealed in place, and, as illustrated in FIG. **3**, they are sufficiently long so that their ends **162** extend, if not to the edges of the base plate, then near these edges and into the region in which the seal occurs. As shown in FIG. **3**, the dash lines represent schematically the extent inwardly from the edges **25** and **27** of the base plate to which the actual seal between the base plate and face plate extends, and it is noted that the ends **162** of the glass rods lie in the seal area.

The glass base plate **20** carrying the anode wires and the glass rods **160** is heated to melt the various quantities of glass frit and to secure the anode wires and the glass rod inserts in place when the assembly cools. A pressure plate is applied to the top surface of the base plate during the heating operation to hold the glass rods **160** in place.

The cathode electrodes **60** and **62** are then provided, and, if the cathodes are wires, they are formed most readily by a winding operation. For such an operation, a short pin **74** is secured in slot **66** but projecting therefrom slightly at upper edge **25** of the base plate, and a similar short pin **76** is secured in the opposite cross groove **68** and projecting therefrom slightly at the lower edge **27** of the base plate. The pins **74** and **76** are secured in the slots with a glass frit cement. When the cathode wire is wound to form the individual cathodes **60** and **62**, one end of the wire is secured to pin **74**, and then it is wound on base plate **20**, with each turn in a slot **70**, and the other end is secured to pin **76**. Before the actual cathode winding operation is performed, a glass frit is placed in the slots **70** for anchoring the cathode wires in place.

The same general procedure would be followed if the cathodes comprised thin metal strips which were set in place as a unit on the top surface of the base plate.

After this cathode winding operation has been performed and the cathode electrode turns have been secured in place, the wound cathode wire is cut to form the individual cathodes **60** and **62**. Finally, the other parts of the panel are assembled with the base plate assembly, and the panel is processed to completion.

What is claimed is:

1. A gas-filled display panel comprising

a glass base plate and a glass face plate hermetically sealed together to form an envelope which is filled with an ionizable gas,

the seal area between said base plate and face plate extending around the perimeters of said base plate and face plate,

said base plate having an array of longitudinal slots in which anode wires are seated,

said base plate also having cross grooves transverse to said slots and positioned one near each end of the base plate, each cross groove being deeper than said slots,

an electrode in each of said cross grooves adjacent to the base thereof, said seal area covering portions of said cross grooves at the periphery of the panel,

an array of cathode electrodes disposed adjacent to and transverse to said anode electrodes and forming an array of rows and columns of gas cells therewith, and

an insulating member secured in each cross groove and extending along each cross groove so that the ends of each member lie within the seal area between the base plate and face plate,

the top surface of each insulating member being generally coplanar with the top surface of said base plate, at least in said seal area, to insure the formation of a hermetic seal between said base plate and face plate at said cross grooves.

2. The panel defined in claim 1 wherein said cross grooves extend completely across said base plate.

3. The panel defined in claim 1 wherein said anode wires extend across said grooves beneath said insulating members.

4. The panel defined in claim 1 and including an apertured electrode plate disposed adjacent to said base plate and said cathode electrodes with an aperture in operative relation with each of said gas cells, and a large-area electrode on said face plate coated with a layer of glass to make it an A.C. electrode.

5. The panel defined in claim 1 wherein said insulating member is a glass rod.

6. The panel defined in claim 1 wherein said insulating member is a glass rod having a generally rectangular cross-section.

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